THE USE OF CLOUDS IN LOCAL FORECASTING.

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SYNOPSIS.—Cloud indications usually agree with those of the weather map, but often contribute additional information. For the longer forecast periods clouds seldom warrant a differing forecast. For shorter periods they are increasingly useful, especially in handling local inquiries during the day.

In formulating rules for cloud forecasting, but little assistance is to be expected from station records, since they omit the speed of clouds and make no distinction between types within the same class. Cloud indications differ in different sections of the country. In the upper Mississippi Valley, at least, certain combinations and sequences of cloud are nearly always followed by definite weather developments.

Various opinions have been expressed as to the actual or possible use of clouds in forecasting weather. For a number of reasons attention to clouds in local forecasting seems justified. Clouds are a visible, and the most conspicuous, stage in the cycle of evaporation and condensation of atmospheric water vapor, and, theoretically, should be of service in forecasting precipitation. The cloud sheet of a LOW is a feature of the weather map commonly considered by meteorologists in arriving at a forecast. Further local use of clouds would be only an extension of existing procedure. The local forecaster is expected to amplify or adapt the district forecast to meet the needs of his community. But except where topography influences weather, the local official has little or no information, outside the map, on which to base any "amplification," except such indications as his sky may afford. Moreover, the local forecaster is nearest the public and should naturally receive numerous inquiries regarding details of expected weather during the 10 or 12 hours immediately in advance—inquiries important to public interests but not covered by the map data, and concerning which the clouds often afford considerable information. In handling this class of inquiries lies one of the largest opportunities of the local official for service to his community.

But when the practical utilization of clouds in forecasting is undertaken, certain limitations and difficulties are encountered. Cloud indications, when present, usually agree with those of the map, though they often give further information. Their use in connection with the published forecasts is chiefly in corroborating or modifying other indications. For the longer periods covered by the published forecasts cloud indications seldom differ with sufficient definiteness from those of the map to warrant a differing forecast, though that sometimes occurs. For the shorter periods clouds become increasingly useful.

It is often difficult to use clouds in the a. m. forecast, because night breaks the continuity of the observer's acquaintance with sky conditions. And the rush of morning work, together with the early preparation of the forecast, frequently makes it impossible to gather up the sky threads in time for that use. This is partly overcome if the work schedule can be arranged to allow the local forecaster time enough for proper cloud observations beginning about sunrise. More use can often be made of clouds in the p. m. forecast where one is issued locally.

In working out definite rules or statements of cloud indications for forecasting, the study of station records appears to be of little direct service. Careful observers have doubtless noticed that some forms and movements of cirrus and cumulus are good indicators of rain, while other forms and movements of the same class of cloud are almost equally good indicators of fair weather. But most records unfortunately make no distinction between forms within the same class. The amount of cloud and the direction of movement are recorded, but the essential element of form or type and the sometimes equally important element of speed, are omitted. Therefore it is thought that statistical studies of cloud occurrence and subsequent weather, based on the usual records, can not be expected to assist beyond a preliminary stage.

The particular forms, movements, and appearances of clouds that are of value to the forecaster naturally differ more or less in different portions of the country, depending on the observer's location with reference to storm tracks, general wind system, the types and stages of storm development commonly experienced, and a number of other elements. The significant types can not readily be presented in description or diagram clearly enough to make their recognition always certain by an inexperienced observer. They must be learned, in part at least, by personal observation and experience before they can be used with confidence. The following notes summarize a few of the results of a study covering more than two decades and carried on in several States from the Plains to the St. Lawrence, but chiefly in the upper Mississippi Valley. They may perhaps be suggestive. No effort is here made to discuss the topics fully. The order is roughly that of cloud types rather than frequency of occurrence or value to the forecaster.

The most useful clouds to the forecaster are cirrus, cumulus, and their modifications.

Generally cirri, to be significant, should move rapidly, or at least at average speed. Cumulus and alto-cumulus may move either slowly or rapidly, depending on associated conditions.

Cirrus, or cirro-stratus, of the right type, either scattered or numerous, moving rapidly from the northwest (north-northwest to west-northwest) across the middle sky, are often followed by rain within 6 to 18 hours; but the clouds must be of the right type and sequence.

(*a*) Exception: If these cirri are the front edge of a cirrus sheet that is spreading from the west or southwest horizon over our sky, they may be connected with a distant western LOW, and our rain will be longer delayed. This occurs oftenest in winter or the cool months.

(*b*) If the cirri, especially in summer, are confined wholly to the lower northeast sky, the rain is likely to follow there and may not reach the observer. The arrangement and extent of the cirri, particularly on their border in the northwest sky, will sometimes indicate in such cases whether the rain will reach the observer. The application of this rule differs somewhat between Peoria and north-central Iowa.

Cirrus or Ci.St., of the right type and sequence, moving rapidly from points between west-southwest and south-southwest, indicate rain or snow next day about four-fifths of the time. Often the rain will begin early, sometimes before morning. If the cirri are present in the morning and thicken rapidly to the lower stratus levels by late forenoon, precipitation (at Peoria) may begin in afternoon of the same day.

(*a*) Exception: The northwest edge of a Ci.St. sheet belonging to a LOW that has passed to southeast of the observer may move rapidly from the southwest without being followed by precipitation. In Iowa even this combination is likely to be followed by at least a trace next day.

(b) Exception: But if, with such a LOW, the cirri lying across the south and southeast sky spread rapidly outward from the south and increase noticeably in density, it is an indication that the LOW is either moving or developing northward and may bring precipitation to the observer. This sometimes occurs when the morning pressure changes did not clearly indicate the northward turn of the LOW. If the LOW is too far east to affect the observer's locality, the successive arrangement of cirri in the southwest sky often shows that fact in advance. When the above movements of cirri from nearly south occur in the morning, precipitation usually follows by mid-afternoon.

Another type of cirrus, or Ci.St., from the southwest or west-southwest, shows by its successive forms and arrangement that rain will occur on the morrow, that it will usually begin before morning, and that the heaviest portion of the storm will pass to northwest of Peoria. This set of indications is seen at Peoria in front of many of the southwest LOWS that were headed toward the Ohio Valley or Tennessee, but turn northward during the day and later cross Iowa. The pressure changes of the morning map may, or may not, have shown this tendency.

In summer detached cirrus clouds appear two to eight hours or more ahead of a large share of the local storms. Often the arrangement of cirri indicates the portion of sky to be traversed by the heaviest portion of the storm. When cirrus plumes or streamers move endwise, or ths wisps and patches of Ci.St. persist, along the same line across the sky, then if there is any marked difference in density or number or in clearness of outline among those clouds, the heaviest portion of the storm will usually follow the path marked by the heaviest or clearest or most numerous cirri. This rule does not hold for Ci. streamers moving obliquely. Sometimes there are bars and streamers moving endwise and others in oblique position but moving in the same direction. In such cases the principal portion of the storm is likely to follow the streamers that move endwise.

Rapidly moving Ci. streamers from west or west-northwest, with or without focal points, when succeeded by broken clouds or patches of clear sky, usually indicate fair weather if the wind accompanying the cirri is fresh from the west; otherwise not.

Cirri from the west, with or without streamers, and streamers with or without focal points, may increase toward mid-afternoon. There may also be other clouds, A.St., Ci.Cu., or A.Cu.; the general cloudiness may break up between 3 or 4 p. m. and sunset, sometimes clearing almost completely. This sequence, with southerly or easterly winds, is an almost infallible indication of rain to begin before morning, often with thunder.

A.Cu., in summer, are one of the most useful rain indicators.

Detached A.Cu., from southwesterly (south to west) points, in the morning, nearly always mean thunder showers in afternoon, most frequently between 2 and 6 p. m. This may not hold just after another storm.

Detached A.Cu. from northwesterly points, in morning, are nearly as useful. Sometimes their rain comes quicker than that after A.Cu. from southwest.

Exception: Occasionally a wind shift or a sprinkle of rain comes with the morning A.Cu. When that occurs no afternoon developments may follow. Under such conditions the morning A.Cu. seem to mark the center of a disturbance that is passing eastward and produces no more showers for that locality. But when A.Cu. occur in morning without rain or wind shift, they are connected with a disturbed or unstable condition to westward that will usually develop Cu.Nb. in the stronger convectional overturn of afternoon.

A.Cu. often mark the paths of showers, or of the heaviest portions of more general thunderstorms, several hours (often four to eight) in advance. Sometimes this is done by detached groups of A.Cu. occurring only in certain portions of the sky or persisting along certain paths; at other times by the formation of lines or bars of heavier or denser development, that move longitudinally, persisting along certain paths. When such bars or lines move obliquely or laterally they do not have the same significance. When scattered bars move laterally, any subsequent associated rain is apt to be brief, and light in amount, unless other cloud indications at the time show otherwise.

In north-central Iowa there occurs a combination of clouds, chiefly cirri and A.Cu., in which A.Cu. cover one-fourth to one-half or more of the sky through midday and much of the afternoon; being preceded and attended by cirri, and clearing toward evening. This is invariably followed by active thunder showers between midnight and morning. The clouds are from westerly points. In a modified form of the combination they may move from the southwest, at least in Illinois. The Iowa combination seldom occurs at Peoria except with modifications.

In northern Iowa, after a clear summer day with southerly wind, the appearance of even a single bar of A.St., or a few fragments of A.Cu., near the northwest horizon at sunset, often indicates scattered showers next day; even though the evening weather map carries no rain in the northwest. The showers may be more or less general, and may arrive by early morning. The occurrence of that evening indication should put the forecaster on guard, unless the evening map shows plainly that no pressure wave is possible. This occurrence seems to be associated with some of the occasional high pressure waves of summer that traverse the north-central border States, without, as a rule, extending their influence very far south. The indication is seldom useful at Peoria.

Cumulus: When conditions favor the development of showers, the cumuli of morning or middle forenoon often show the paths to be followed by afternoon showers. In some seasons and in certain types of weather this indication has frequently been found useful, particularly in Iowa.

There are many cloud indications that will reward the attentive meteorologist with considerable assistance in serving his community.

HIGHWAY WEATHER SERVICE.

During the winter of 1918–19 the Highway Weather Service was in operation to a greater or less extent at some 23 stations in 13 States. At most of these stations, principally in the northern States, it was a winter service only and was discontinued in the spring to be resumed the coming winter. At a number of stations, however, the service has been continuous.

This Service, now entering its third season, consists mainly of the collection and distribution of information in relation to the condition of the main State highways and of the dissemination of warnings of expected cold waves and heavy rains or snows. At some stations that are corn and wheat region centers the information is obtained from such of the substation observers as are located on or near the main highways, a word to represent the road conditions, as "Good," "Passable," "Bad," etc.,